SMU 56/57 Demonstration Project Air Monitoring
Executive Summary

Background and Purpose

The sediment contamination of the Lower Fox River in Wisconsin by polychlorinated biphenyls (PCBs) has been the subject of numerous studies. The majority of these studies have focused on characterizing the extent of the contamination, and have dealt with a variety of environmental compartments, including sediments, biota, water and air.

Comparison of the results from these studies with similar ones conducted elsewhere has shown the Fox River to be the greatest single source of these contaminants to the upper Great Lakes. A significant body of research exists correlating increased ambient air concentrations associated with contaminated sediments. The limited studies conducted by DNR Air Monitoring as part of the Wisconsin Urban Air Toxics Monitoring Program (WUATM) qualitatively support this correlation.

Controversy surrounds the problems posed by the presence of PCBs, and potential solutions to the situation. Two demonstration projects have been conducted to determine whether dredging can be accomplished in an effective manner. The design of these projects has included environmental monitoring to establish whether dredging results in increased mobilization and loss of PCB to the surrounding area. A mass balance approach incorporating process data for evaluating success of the projects has been attempted, the goal being to document the fate of the contaminated material in a clear manner.

The first demonstration project was conducted at Deposit N near Kimberly and included pre- and post- dredging sediment sampling, as well as up- and down-stream water sampling during dredging. Process data collected included volume, moisture and PCB content of both the freshly dredged and processed materials. No air monitoring for PCBs was conducted as part of this project.

The second remediation demonstration project was conducted at Sediment Management Units 56 and 57, located about halfway between the DuPere dam and the mouth of the river in Green Bay. This area contains some of the highest PCB concentrations observed in Fox River sediments. A similar level of monitoring was proposed by the DNR to accompany this project to evaluate the effectiveness of and risk associated with dredging as a remediation method.

However, potential loss of PCBs to the atmosphere during sediment removal and treatment, and the risk that could accompany dispersion, were raised as possible objections to further dredging. Ambient air monitoring was then incorporated into the overall environmental monitoring plan. This report documents and evaluates all air monitoring data collected during the course of this project.

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Objectives of air monitoring associated with this project were to:

- Evaluate potential loss of PCB during sediment remediation
- Estimate emission rate for comparison with mass balance process data
- Assess potential air-associated health risks
- Determine whether air monitoring should be a required remediation activity

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A total of 326 air samples were submitted for total PCB as Aroclor analysis during the course of this project. Of these, 204 (62.6%) were ambient samples associated with the dredging area, 31 (9.5%) associated with the landfill, 34 (10.4%) from more distant background locations, and 57 (17.5%) quality control samples.

All laboratory quality control objectives were met, with the exception of sample holding time. Sampling data quality objectives were met in most cases. A few individual sites failed the completeness criteria, while a single quality control sample fell outside of the acceptable range. The Data Quality Review section discusses these parameters.

The project was split into two distinct portions, one conducted on a 24 hour sampling basis, with the latter half consisting of a 72 hour sampling regime. The purpose of the different sampling times was two-fold. First, 24 hour samples were collected to improve the ability to compare results with process data. Then, because background concentrations are close to the Limit Of Detection (LOD) on a 24 hour basis, the sampling period was extended to 72 hours to lower the detection limit.

Ambient concentrations observed during the 24 hour sampling regime ranged from ≈0.3 – 1.6 ng/m^3 at all sites sampled before dredging began, and from <0.2 – 79.7 ng/m^3 during the dredging and sediment processing. Concentrations from samples collected within the property boundaries of the remediation area ranged from ≈0.7 – 79.7 ng/m^3 during dredging, while off property concentrations ranged from <0.2 – 3.6 ng/m^3.

Ambient concentrations ranged from ≈0.1 – 21.6 ng/m^3 during the 72 hour sampling portion of the project. Concentrations from samples collected within the property boundaries of the remediation area ranged from 1.3 – 21.6 ng/m^3 during dredging, while off property concentrations ranged from ≈0.1 – 2.3 ng/m^3.

Most landfill oriented samples throughout the project were at or below the urban air background results obtained concurrently. Two results obtained from these locations were distinguishable from the urban background. All results are presented in the Results Discussion section.

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While ambient concentrations were elevated by the sediment removal and treatment, evaluation of the results shows that concentrations observed at sites greater than 1250 meters (during the 24 hour sampling) or 750 meters (during the 72 hour testing) from the remediation work area were indistinguishable from the urban background concentration. These conclusions are explored further in the Data Evaluation section. It should be noted that these observations were made during remediation of the most contaminated stretch of the river, and that other areas may be expected to have even smaller impacts.

Emission estimates based on the data were conducted in three separate ways: using a standard dispersion equation, and comparing the ambient results to two modeling scenarios. In all cases, the most conservative assumptions were made to estimate maximum potential emissions.

All three of the estimates are consistent and indicate an approximate emission rate between 0.01 and 0.1 pounds per day. This corresponds to a total possible loss to the atmosphere of up to 10.7 pounds. This represents 0.8% of the estimated 1326 pounds of PCB removed from the river bottom during the dredging project. The scenarios used for the calculations are discussed in the Emission Calculations section.

Health risks associated with ambient PCB concentrations are evaluated against an established EPA standard unit risk value is 1.1×10^{-4}, based on a concentration of 1.0 ug/m^3 (1000 ng/m^3). This means that if someone was exposed to this concentration in air for 70 years, they would have a roughly one in 10,000 risk of developing cancer that could be attributed to this exposure.

For the purposes of this evaluation, a more conservative ambient level of concern was set 100 ng/m^3, at which concentration a 70 year exposure could be attributed to a single cancer out of 100,000 people. No samples exceeded this level. Comparison of the results with the urban background indicates that the most concentrated samples elevated the risk level by up to 120 times. These results were obtained within the remediation exclusion zone. Risk off-site was raised no more than 10 times above the background level.

In contrast, it should be noted that eating one contaminated fish may expose an individual to more PCB mass than breathing the air at the most contaminated site constantly for more than 300 days (which is longer than the project lasted). Discussion of the risk and how it was evaluated is presented in the Risk Assessment portion of the Data Analysis section.

These results may be summarized in the following manner:

1) Dredging and processing of contaminated sediments resulted in locally elevated ambient PCB levels.

2) Elevated levels did not exceed the conservative level of concern adopted for this project.

3) Locations greater than 1 kilometer away from the project area were not significantly affected.

Overall, these results indicate that PCB loss to the atmosphere plays a minor role during sediment remediation projects of this nature. It should be noted, however, that there is a significant temperature dependence with PCB volatilization, and that losses are likely to be greater during warmer months. In spite of this, it appears that air monitoring does not need to be required during remediation efforts. A low level of monitoring associated with the Urban Air Toxics program continues in the Green Bay area.

Author's Notes on Using This Report

Many technical reports published for general use simply present the results and conclusions drawn from them. This seems a flawed approach for several reasons. First, there is no indication of the confidence associated with the results (not only how sure are the authors about a particular value, but how representative of the general state being studied is the value). Without complete presentation and discussion of data, the reader is forced to attempt to read between the lines of the report, or contact the author to answer questions about the reliability of the conclusions.

Beyond this, this approach tends to obscure the fact that complex environmental analytical results represent probabilities, rather than definite realities, and that any given set of data can be interpreted in more than one way. Presenting only results and conclusions can then end up leaving the reader with the impression that a situation that *could* exist does in fact prevail, and may lead to a tendency to ignore the consideration that other interpretations of the data are possible. In addition, it may be difficult to understand how the author arrived at the conclusions that they did.

To address these issues, this report contains a comprehensive Data Quality Review, which goes into significant detail of how reliable the results obtained are from a variety of angles. If one chooses to simply accept that the data are sufficiently reliable to produce the conclusions drawn, this section may be skipped.

In addition, the Project Overview section addresses the design of the project in detail. Detailed descriptions of the sampler locations, methodologies and protocols employed in the testing are included. While this section contains significant information, it is not vital to understanding the overall report.

Another questionable aspect of simply reporting results summaries and conclusions is a simple mathematical one. The average of 1, 10, 100 and 1000 is 277.75. As is the average of 277, 278, 278, and 278. Simply reporting that an average value of 277.75 was obtained from a particular set of four samples does not adequately represent what the

actual conditions observed are, and results reported herein contain maximum and minimum values, along with the average and percent relative standard deviation.

All results obtained are discussed both as individual values, and grouped in a variety of ways to provide clear indications of the range of ambient conditions observed. A significant amount of discussion in the Data Evaluation and Emission Calculation sections is devoted to how the conclusions drawn from the data were derived.

It should also be noted that certain words have particular meanings when used in this report. Most important among these are “significant”, which refers to statistical differentiation between values and does not in any way relate to the importance of the results; and “impact”, which simply refers to an observable difference that can with confidence be related to the remediation activity that is the focus of this study, without any negative or positive connotations.

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